

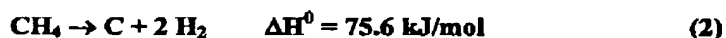
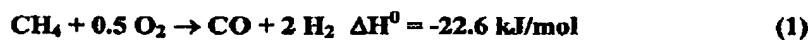
Ir and mixtures thereof, m is the mole ratio of T/A, which mole ratio is from about 0.01 to about 10; A is an alkaline earth element selected from Mg, Ca, Ba, and Sr and mixtures thereof, and n is the number of oxygen atoms needed to complete the valence requirement of the transition and alkaline earth elements. The Examiner lists the various process steps of Chourdary.

The Examiner argues that Chourdary discloses a process of decomposing methane using a catalyst composition containing Ni and Mg, and the claimed Ni to Mg mole ratios, and process of preparing thereof, except for the % of Ni presently claimed, which is from about 15% to 95% in the metallic state with greater than about 25% being in the active state. It is the Examiner's position that it would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made to have optimized the nickel concentrations in the process of Chourdary in order to achieve an effective catalyst or a catalyst composition having the desired Ni concentrations because it is known in Richter to produce a catalyst having Ni in the amount of up to 89.5% by weight.

With respect to the claimed methane conversion temperatures, it is considered the claimed temperatures are met by the teaching of the reference since they fall within the disclosed temperature range (See Chourdary Examples 15-18).

Applicants' Position

It is applicants' position that Choudhary teaches a process for the preparation of composite catalysts useful for the conversion of methane via partial oxidation to synthesis gas (mixture of CO/H₂). In contrast, the presently claimed catalysts are useful for the direct catalytic decomposition of methane to hydrogen and solid carbon. Methane partial oxidation and methane decomposition are two entirely different types of reactions and would require entirely different catalysts. The former reaction is a mildly exothermic process (reaction 1) whereas the latter reaction is moderately endothermic one (reaction 2).



It is known that Ni-based catalysts can be used to catalyze both reactions. During methane partial oxidation reaction, the atmosphere in the reactor is both reductive and oxidative due to the coexistence of reductive (CH_4 , H_2 , and CO) and oxidative (O_2 , H_2O , and CO_2) compounds. On the other hand, the atmosphere is solely reductive during methane decomposition because of the presence of reductive compounds (CH_4 , H_2 , and carbon) only. For this reason, no single catalyst can be used for both reactions. For example, the metallic sites of the catalyst are subjected to oxidation and reduction during methane partial oxidation, while the active sites are always in the reduced state during methane decomposition.

Applicants' submit herewith a Declaration under 35 USC 1.132 that contains experimental evidence that the catalyst compositions of Choudhary are not the same as those instantly claimed. Example 15 of Choudhary was followed in this Declaration because it represents the closest to the instantly claimed invention. That is, Examples 1-14 of Choudhary relate to the preparation of NiO-CaO catalysts and their use in the oxidative conversion of methane to synthesis gas. Example 15 of Choudhary relates to the preparation of a NiO-MgO catalyst composition at a Ni/Mg ratio of 1.0. Example 17 relates to the preparation of a NiO-MgO catalyst with a Ni/Mg of 3.0. Thus, Example 15 of Choudhary is the closest to the instantly claimed catalyst because both contain Ni and Mg in a ratio of 1 to 1.

The data of the enclosed Declaration shows that even if the catalyst of Example 15 of Choudhary is reduced at 500°C in a hydrogen-containing atmosphere (see Choudhary example 6) the amount of Ni in the metallic state is lower than the detectable limits of the analytic equipment and the hydrogen yield and the yield of solid carbon on also below the detectability limits of the analytic instruments. Therefore, the catalyst compositions of Choudhary are not the same nor do they suggest the instantly claimed catalyst compositions require s at least 15 % of the nickel be in the metallic state and at least 25% of those sites be in the active state. Substantially all of the nickel sites of the Choudhary catalysts are in the oxide state.

Richer relates to a Raney nickel mixed catalyst used as a fuel cell electrode. The catalysts of Richer are comprised of metals only (Ni-Mo-Ti or Zn, whereas the instantly claimed catalysts are a mixture of metal (Ni) and a metal oxide (MgO). As can be seen from Table 1 of the instant application, at a reaction temperature of 550°C, in the absence of MgO, the unsupported metallic Ni catalyst provided no activity for methane conversion, evidencing the criticality of the presence of the MgO component. This is clearly outside the scope of Richer.

In view of the above and the submission of the Declaration under 35 USC 1.132 it is requested that the Examiner reconsider and withdraw this rejection.

Second Rejection Under 35 U.S. C. 103(a)

Claims 6-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chourdary in view of Richter and Bournonville et al. (Bournonville).

Examiner's Position

The Examiner argues that Chourdary discloses a process of catalyzing a conversion of methane in view of Richter for the teaching of the Ni concentration for the catalyst composition as discussed above, except for the "Cu", and the molar ration of Ni to Cu. It is the Examiner's position that it would have been prima facie obvious to one having ordinary skill in the art at the time the invention was made to have incorporated Cu into the catalyst composition of Chourdary in order to achieve an improved catalyst having higher catalytic activity because it is known in the art to add an additional metal component, such as Cu, to a Ni catalyst to result in a catalytic reaction catalyst, as evidenced by Bournonville (Col. 11, claim 1)

Applicants' Position

Choudhary and Richer have been discussed above, particularly with reference to the Declaration under 35 USC 1.132 submitted with this response. Bournonville teaches the use of a

Raney nickel type of catalyst to catalyze the dehydrogenation of a secondary alcohol to the corresponding ketone. The catalyst contains nickel and 0.1 to 10 wt.% of an additional metal selected from Cu, Ag, Au, Sn, Pb, Zn, Cd, In, and Ge. The additional metal produces a substantial decrease of the hydrogenolysis parasitic reaction, which results in an increase of the selectivity by producing hydrogen of sufficient purity. Raney nickel type catalysts consist of metals only whereas the Ni-Cu-MgO catalyst of the instant invention contain MgO as a critical component as can be seen in the data presented in Table 2 of the instant application. At a temperature of 725°C, in the absence of MgO, the unsupported metallic Ni-Cu catalyst provided no activity at all for methane conversion, evidencing the necessity for the presence of MgO as a dispersing agent in the catalyst. This is outside the scope of Bournonville, as well as Chourdary.

Applicants' also request that the Examiner reconsider and withdraw this rejection.

Applicants' attorney notes that prior art has been made of record but has not been cited against the instant claims.

In view of the above, it is applicants' position that the claims, as now presented define a patentable invention over the art. Therefore, applicants request that the Examiner pass this application to allowance.

Applicants' attorney notes that prior art has been made of record but has not been cited against the instant claims.

In view of the above, it is applicants' position that the claims, as now presented define a patentable invention over the art. Therefore, applicants request that the Examiner pass this application to allowance.

Respectfully submitted,

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